

OBSERVATIONS ON A YOUNG PYGMY KILLER WHALE (*FERESA ATTENUATA* GRAY) FROM THE EASTERN TROPICAL PACIFIC OCEAN

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ABSTRACT. — An early juvenile specimen of *Feresa attenuata* was captured in May 1967 during commercial tuna fishing operations off Costa Rica. This is the first record of this species from the eastern Pacific and from North American waters. Discrepancies in external morphology and in osteology were noted between the specimen and earlier described adult specimens from Hawaii, Japan, and Senegal, but full analysis of the differences must await the capture of adult animals from the eastern Pacific or juveniles from the other parts of the range.

RESUMEN. — En mayo 1967, durante las operaciones comerciales de pesca atunera frente a Costa Rica, se capturó un espécimen juvenil de *Feresa attenuata* en su primer ciclo vital. Esta especie es la primera registrada en el Pacífico oriental y en aguas norteamericanas. Se observaron diferencias en la morfología externa y en la osteología entre este espécimen y especímenes adultos descritos anteriormente, provenientes del Hawái, Japón y Senegal, pero el análisis completo de las diferencias no se obtendrá hasta que se capturen animales adultos del Pacífico oriental o juveniles de otros lugares en los límites de distribución.

The pygmy killer whale, *Feresa attenuata* Gray (1875), is one of the least known of the delphinids. Gray (1871) based the genus *Feresa* on a skull first described as *Delphinus intermedius* Gray, from an unknown locality. Gray (1875) later proposed the species *Feresa attenuata* on the basis of another skull, from the "South Seas." The synonymy and nomenclature of the species have been elucidated by Fraser (1960).

The external appearance of the animal remained unknown and its geographical distribution remained almost undetermined for three-fourths of a century, until Yamada (1954) described a specimen from Taiji, Honshu, Japan, and gave it the vernacular name used here. Thereafter the known range of the species was rapidly expanded, and its characters were made more fully known. Cadenat (1958) and Fraser (1960) reported on a specimen from Senegal, Africa. Nishiwaki et al. (1965) dealt with further material from Japan. Pryor, Pryor, and Norris (1965) described a specimen from Hawaii. There is no evidence that this species has ever occurred in Australia (Dawbin, pers. comm.; cf. Slijper, 1962: 345).

There has been no previous evidence that *Feresa attenuata* occurs in the eastern Pacific, although Hall and Kelson (1959: 830) stated that it "may occur in Pacific waters of North America." Possibly it was observed long ago in the tropical eastern Pacific, but Scammon's (1874: 104) description of the "Panama grampus" in Bahía de Panamá is not sufficiently detailed to allow specific identification.

The first definite indication of *Feresa attenuata* in the eastern Pacific Ocean is furnished by a juvenile male specimen taken in early May, 1967, approximately 300 to 400 nautical miles off Costa Rica. It was collected by Anthony Dutra, a commercial fisherman of San Diego, California, during tuna-seining operations, such as have recently been described (Perrin, 1969). The net had been set on a school of "whitebelly porpoise," presumably *Delphinus* sp. Mr. Dutra recognized the specimen as representing a species that he had never seen before and saved it in the ship's freezer. It is almost certain that this juvenile porpoise was accompanied by its mother, which apparently escaped during the purse-seining operation. On return to San Diego, Mr. Dutra had a trophy cast made by a

taxidermist, who brought the carcass (Fig. 1) to Scripps Institution of Oceanography for identification. The specimen was identified as a juvenile male of *Feresa attenuata* on the basis of form, size, coloration, and tooth number. The specimen was photographed, measured, and skeletonized. The flippers and flukes were reconstructed from measurements and tracings of the cast. The skeleton, a cast, and drawings of the flippers and flukes are deposited in the Natural History Museum of the San Diego Society of Natural History (No. 21561).

Whether this delphinid regularly inhabits eastern Pacific waters is unknown. That an experienced and interested tuna fisherman recognized the specimen as of a species he had never seen before, and that the species has not previously been observed by us or by colleagues during extensive operations in the area of the eastern Pacific where tuna are commonly caught, suggests that the juvenile (and the adult female) may have been a straggler to the eastern Pacific from the Indo-Pacific area, in which respect this species would be far from unique among marine organisms of the tropical Pacific (Ekman, 1953; Briggs, 1961; Hubbs and Rosenblatt, 1961; Rosenblatt and Walker, 1963).

The general offshore area wherein the specimen was caught is about the warmest in the eastern Pacific, with mean surface temperatures averaging about 28° C. during May (LaViolette and Seim, 1969). This might be taken to indicate that the species is of high-seas, tropical distribution, but other records of the species hardly confirm this. Whereas the first specimen from Japan (Yamada, 1954) and the specimen from Hawaii (Pryor et al., 1965) were captured in areas and during months when the surface temperatures average approximately 26.5 and 23.5° C., respectively (LaViolette and Seim, 1969), the later specimens from Japan (Nishiwaki et al., 1965) were taken from water at 13.5° C., in January, 1963. This wide range of occurrence relative to water temperature leaves us with little basis for predicting the probable distribution of the species.

EXTERNAL MORPHOLOGY

The specimen from off Costa Rica was a juvenile male 822 mm. long, from tip of upper jaw to the notch in the flukes. Unerupted teeth and the small size indicate that the animal may have been newly born. As received by the authors, minus flippers, fluke tips, and viscera, and probably somewhat dehydrated by freezing, it weighed 9.37 kg. It does not seem to differ from previously described specimens except in respects that reflect its youth.

External measurements were taken of the young specimen for comparison with those recorded by Pryor et al. (1965) for an adult male from Hawaii and by Nishiwaki et al. (1965) for 14 adult specimens and 1 fetus from Japan. Our measurements were made point-to-point on the left side, with a large pair of precision calipers. Pryor et al. and Nishiwaki et al. made their measurements according to the methods proposed by the Committee on Marine Mammals of the American Society of Mammalogists (1961), which for several applicable dimensions specify axial projections rather than point-to-point measurements. We feel that the point-to-point method is the more precise, is readily applicable for smaller cetaceans, and yields values that are convertible into axial projections, provided that good photographs in several aspects have been made. Our measurements in millimeters, with thousandths of total length from the tip of upper jaw to notch in flukes in parentheses (computed from axial projections where appropriate), were: total length to notch of flukes, 822; tip of upper jaw to center of eye, 82(100); tip of upper jaw to end of gape, 69(84); tip of upper jaw to blowhole, 76(92); tip of upper jaw to insertion of flipper, 186(226); tip of upper jaw to origin of dorsal fin, 389(473); tip of upper jaw to tip of dorsal fin, 521(634); tip of upper jaw to midpoint of umbilicus, 393(478); tip of upper jaw to midpoint of genital aperture, 485(590); tip of upper



Figure 1. *Feresa attenuata*. Top to bottom: right lateral view; dorsal view; ventral view; close-up of head in right lateral view.

jaw to center of anus, 555(675); tip of upper jaw to origin of flukes, 747(909); tip of upper jaw to plane of maximum girth, 379(461); maximum girth, 554(674); girth at axilla, 540(657); girth below origin of dorsal fin, 540(657); girth above anus, 302(367); center of eye to end of gape, 31(38); eye length, 17(21); eye height, 9(11); blowhole length, 6(7); blowhole width, 18(22); length of slit from umbilicus to anus, 155(189); length of mammary slit, 2(2); length of anal slit, 13(16); insertion to tip of flipper, 160(195); maximum width of flipper, 58(71); height of dorsal fin, 77(94); length of dorsal fin base, 130(158); tip to tip of flukes, 210(255); notch to nearest margin of fluke, 73(89); thickness of blubber at origin of dorsal fin, 13(16).

Some of the proportions for the eastern Pacific specimen, despite the discrepancies in age, fall within the ranges given for other specimens. A notable exception is the girth, which probably was affected by the stuffing of our specimen during the casting process. In a number of the proportions, those involving the dimensions of the anterior parts, the eastern Pacific specimen has high or extreme values. This can be taken to reflect the youth of our specimen. For these measurements, the fetus from Japan was even more extreme.

The long ventral groove extended from the umbilicus to the anus, as in the previously described adult specimens. Four bristle follicles were visible on the right side of the upper jaw and three on the left side.

Repeated freezing and thawing of our specimen no doubt obscured some of the more labile features of the pigmentary pattern, such as the pale lateral area described by Nishiwaki et al. (1965). In the discernible pattern, however, our specimen resembled the one from Hawaii (Pryor et al., 1965) more closely than those from Japan (Yamada, 1954; Nishiwaki et al., 1965), in that the ventral white patch extended from around the umbilicus in a narrow wedge past the anus almost to the caudal end of the tail stock, rather than ceasing at the anus. A prominent light patch between the flippers corresponded roughly with the gray area described by Nishiwaki et al.

White markings edged each jaw, the upper the more conspicuously and the more extensively. On the upper jaw the whitish areas broadened anteriorly, but these were separated by a blackish area on the midline and tended to grade above into the blackish snout, whereas posteriorly the coal-black and pure-white areas contrasted fully along the line of contact. The white margin on the lower jaw was much narrower, and was largely confined to the front of the mouth. No trace was evident of the irregular white blotches that Pryor et al. (1965) observed, and regarded as scars, in the adult male from Hawaii.

SKELETON

The entire skeleton was preserved to augment the very limited material available of this species. Because the specimen was a juvenile, perhaps newly born, the skull was very incompletely ankylosed, and some of the postcranial elements were incompletely ossified (Figs. 2-8).

Our measurements of the skull in millimeters (with thousandths of condylobasal length in parentheses) were: condylobasal length, 198.5; length of rostrum, 76.5(385); width of rostrum at base, 50.3(253); width of rostrum at mid length, 37.9(191); width of premaxillae at midlength, 21.9(110); greatest width of premaxillae, 46.9(236); tip of rostrum to anterior margin of superior nares, 105.3(530); preorbital width, 95.5(481); postorbital width, 109.8(553); midorbital width, 101.2(510); maximum width of blowhole, 30.3(153); zygomatic width, 109.5(552); length of left mandible, 144.3(727); length of right mandible, 143.5(723); left coronoid height, 39.3(201); right coronoid height, 40.5(204); length of symphysis, 11.1(56); length of left upper tooth row, 51.5(259); length of right upper tooth row, 52.4(264); end of left upper tooth row to tip of premaxillae, 61.4(309); end of right upper

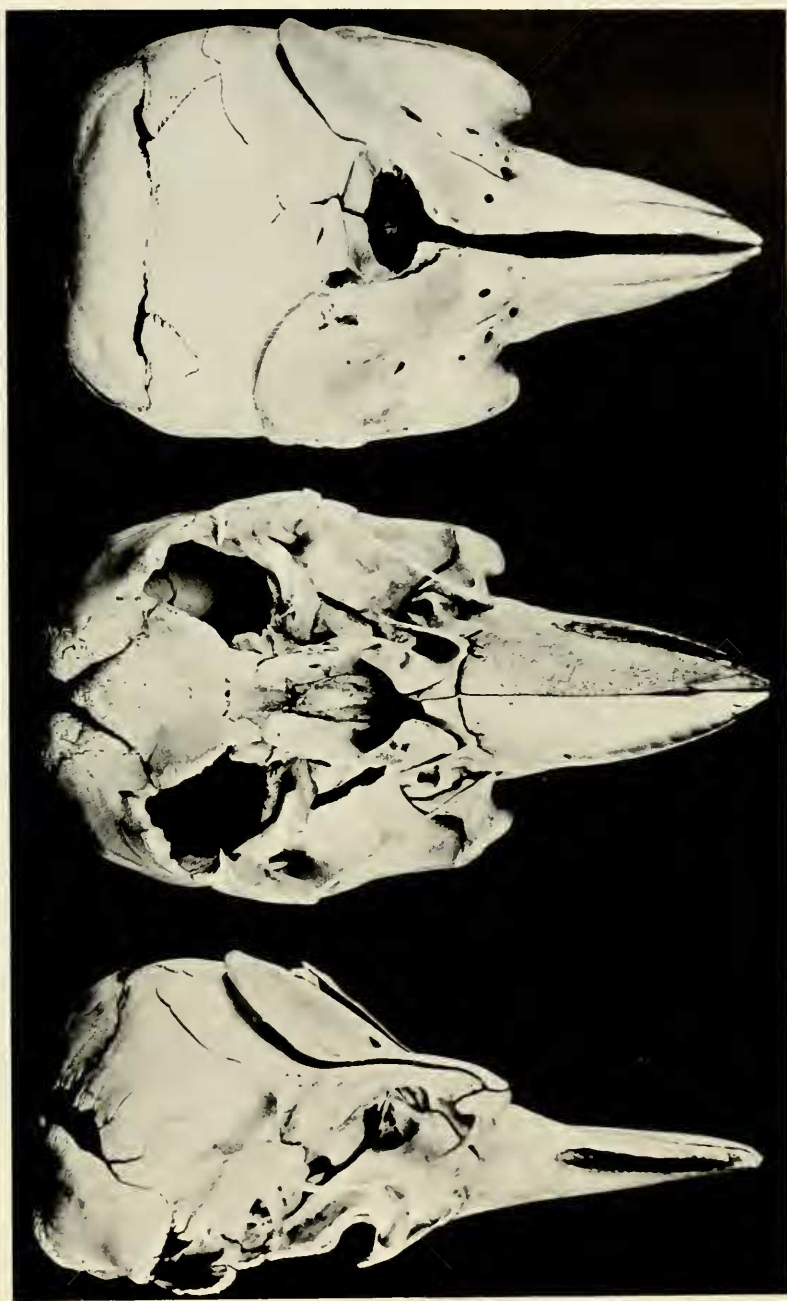


Figure 2. Skull of *Feresa attenuata*. Top to bottom: dorsal view; ventral view; right lateral view.

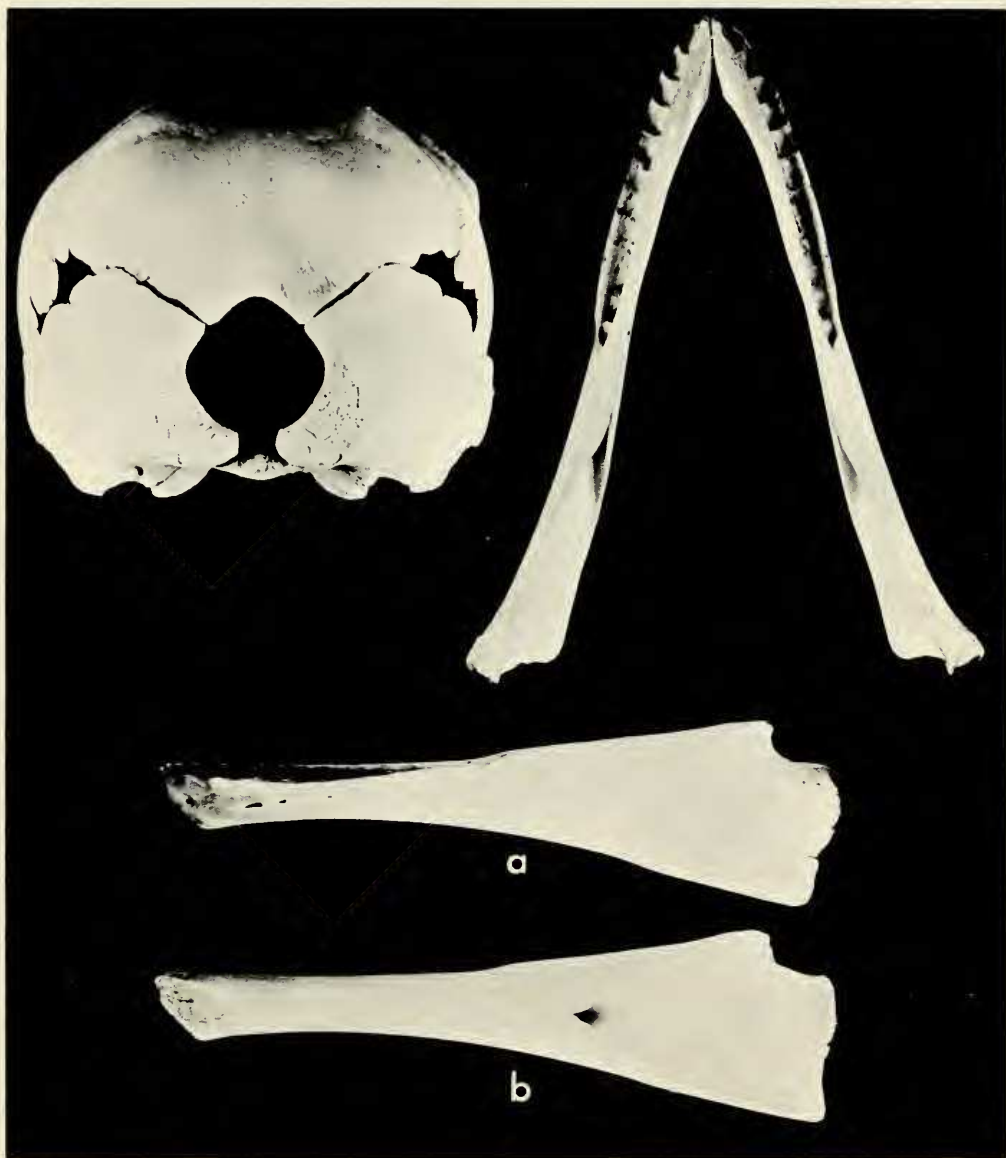


Figure 3. *Feresa attenuata*. Top left, posterior view of skull; top right, mandible, dorsal view; bottom (a) right ramus of mandible, medial view; (b) left ramus of mandible, lateral view.

tooth row to tip of premaxillae, 62.6(315); length of left lower tooth row, 70.1(353); length of right lower tooth row, 71.4(360); end of left lower tooth row to tip of mandible, 73.2(369); end of right lower tooth row to tip of mandible, 74.4(375); length of bulla of left tympano-periotic complex, 33.7(170); width of bulla of left tympano-periotic complex, 21.4(108); internal length of the braincase, 91.2(459). The tooth counts were 9/9 in the upper jaw and 12/12 in the lower jaw for a total of 42 teeth.

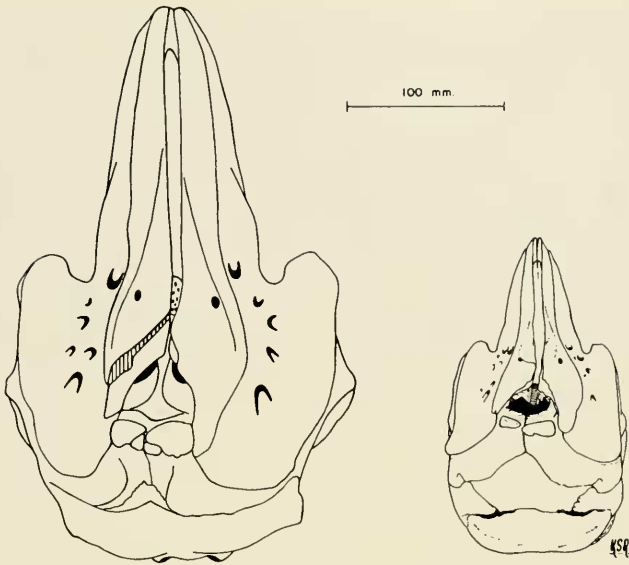


Figure 4. Left, skull of type of *Feresa attenuata* B.M.N.H. no. 1874.11.25.1 (after Fraser, 1960). Right, skull of juvenile specimen from Costa Rica, S.D.S.N.H. no. 21561.

Measurements of the skull were compared with those for the type specimen of *Feresa attenuata* (British Museum No. 1672a); for the type specimen of *F. intermedia* (British Museum No. 362a), synonymized with *F. attenuata* by Fraser (1960); and for recently collected adult specimens from Hawaii, Japan, and Senegal. Differences in proportions between the Costa Rica juvenile and the adults from other areas presumably are due to great ontogenetic changes in skull structures. However, as the skull of the juvenile became disarticulated during maceration, it is possible that proportions calculated from measurements made after the cranium had been reassembled are slightly distorted.

The juvenile from off Costa Rica differs strikingly from the adults in the small proportionate size of the rostrum (Fig. 4); this is consonant with the general pattern of development in mammals, especially those with large brains; the areas concerned with feeding grow more slowly than the brain case. The dentigerous portions of the jaws are also

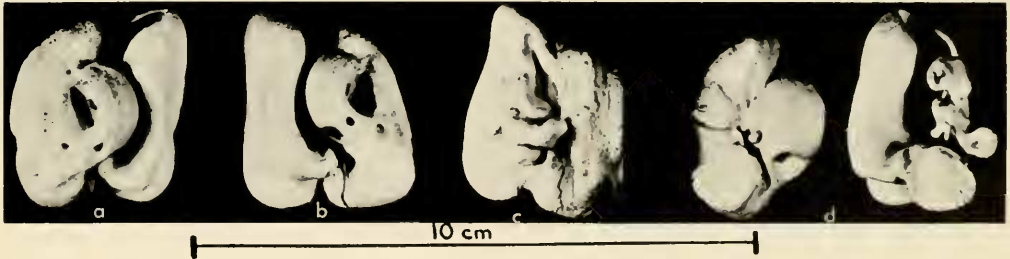


Figure 5. *Feresa attenuata*. (a) left tympano-perioticum, medial view; (b) right tympano-perioticum, medial view; (c) left tympano-perioticum, lateral view; (d) right tympano-perioticum disarticulated to show stapes (left), incus and malleus.

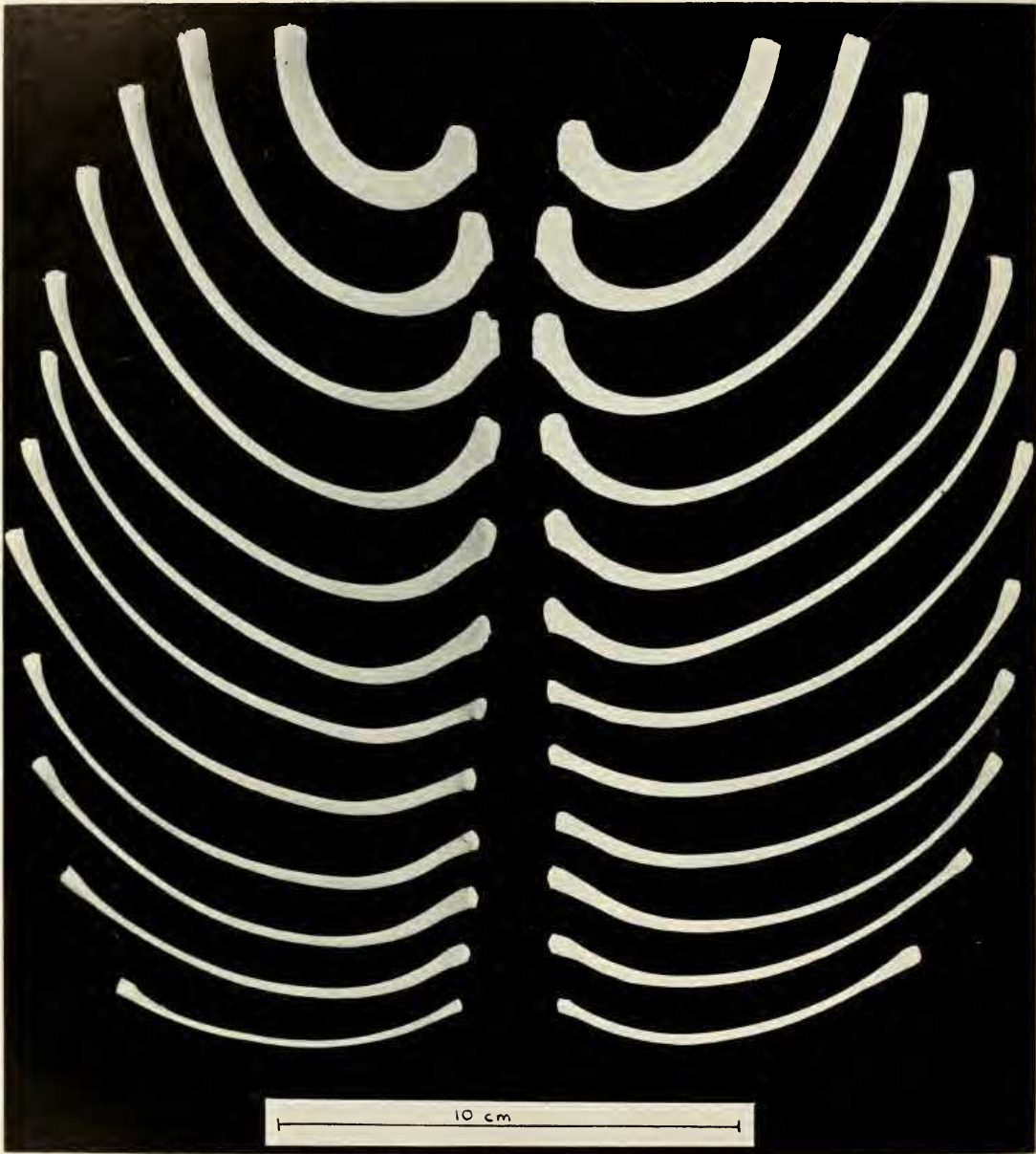


Figure 6. Left and right vertebral ribs of *Feresia attenuata*. Anterior most ribs at top.

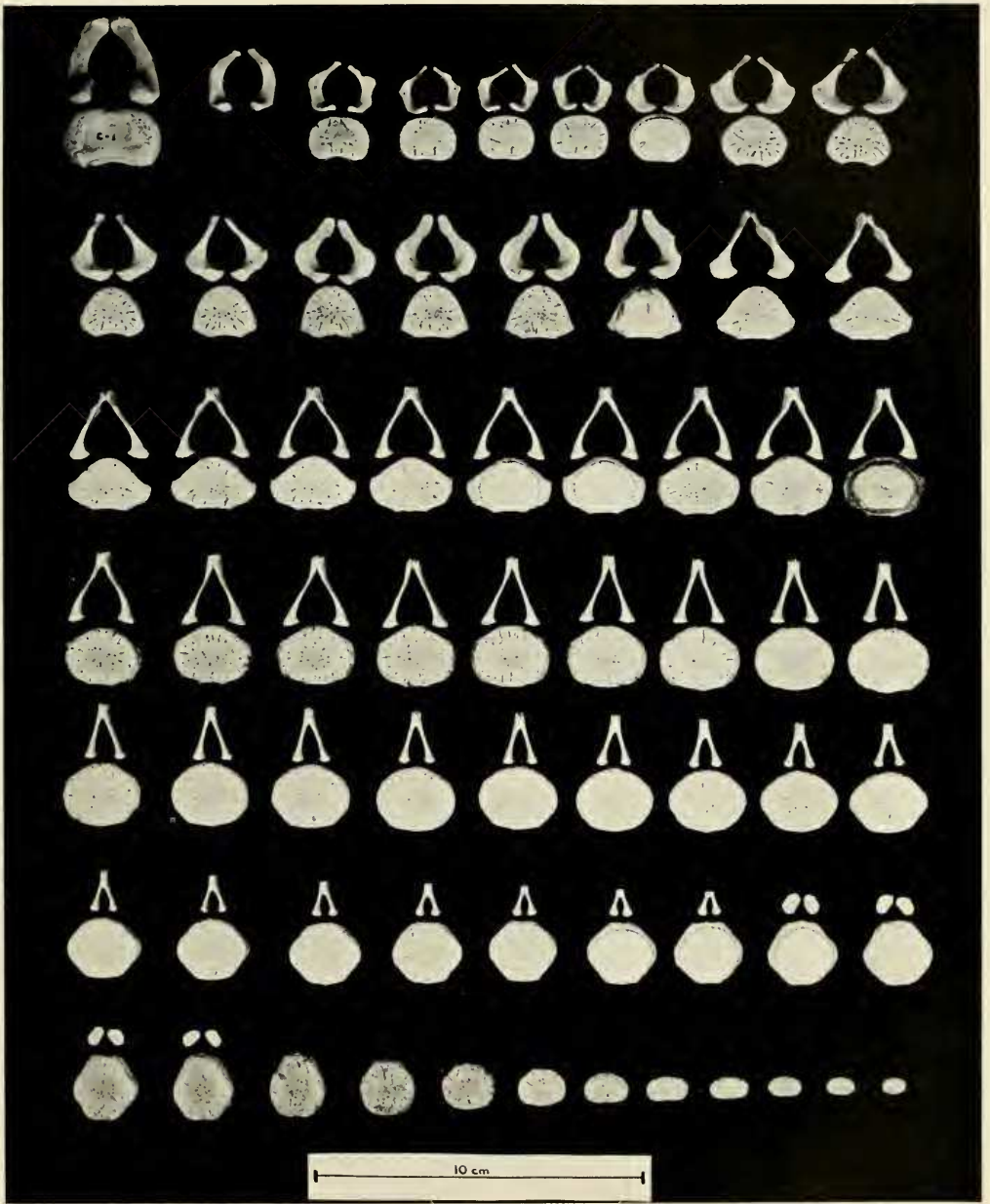


Figure 7. Vertebrae of *Feresa attenuata*, cranial view. Second cervical vertebra fused to first. Halves of neural processes on vertebrae 1-14 and 52-55 not ankylosed, shown in anteromedial view. Intervertebral discs present on some vertebrae. The vertebral column became partially disarticulated during maceration, consequently some elements may be out of order in this photograph.

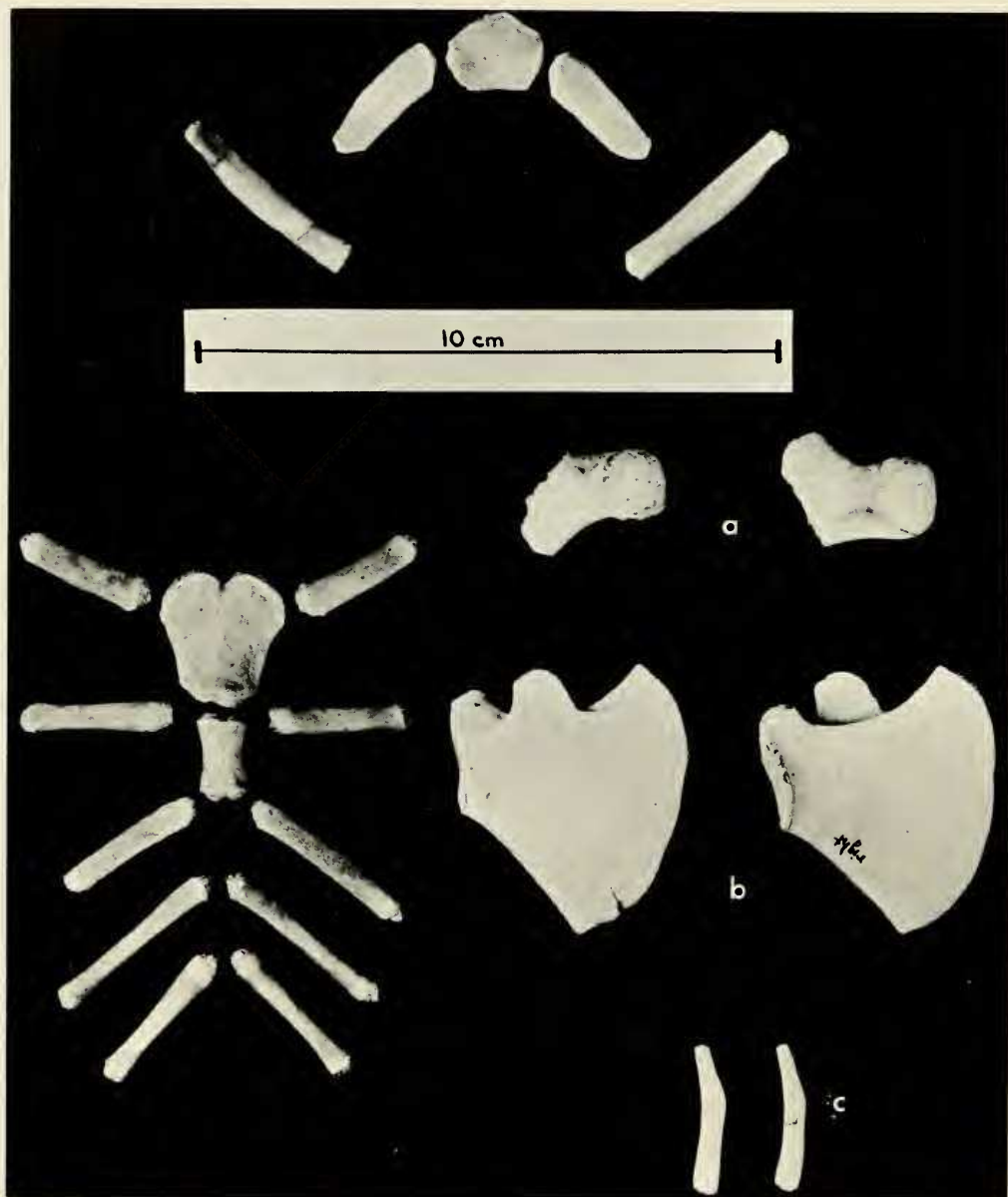


Figure 8. *Feresia attenuata*. Top, hyoid bones; bottom left, sternum and sternal ribs; bottom right. (a) proximal ends of humeri; distal ends severed and missing; (b) scapulae; (c) pelvic bones.

proportionately shorter than in the adults. The mandible (Fig. 3), however, is proportionately nearly as large as in the adult. The premaxillae are narrow near the middle, but the greatest width is not very different. The whole skull is narrower than in the adult (Fig. 4), especially in the region of the orbits and across the zygomatic arches. The condylobasal length is 1.90 times that of the parietal width in the juvenile, as compared with 1.42 to 1.73 times in the adults described by Nishiwaki et al. (1965). The skull has not become telescoped as far as in the adults: large expanses of the frontals and parietals remain visible in dorsal view.

Fraser (1960) stated that in the adult skulls of *Feresa* that he examined, the dorsal surface of the rostral portion of the premaxillae is flat and on the same level as the adjacent maxillae, a condition similar to that in *Orcinus* and *Lagenorhynchus*. In our specimen the premaxillae form a considerable convexity above the level of the maxillae (Fig. 2) in the distal two-thirds of the rostrum, a condition approaching that in adults of *Stenella*, *Tursiops*, and *Delphinus*.

The tympano-periotic complex (Fig. 5) is very large proportionately in comparison to that of the adults, viz., 170 thousandths of condylobasal length versus a range of 102 to 114 thousandths for the Japan specimens, in length; and 108 thousandths versus a range of 62 to 90 thousandths, in width of the bulla. The strong mastoid process figured by Yamada (1954) is not evident. In this respect the juvenile specimen is more like adults of *Grampus*, *Delphinus*, *Stenella* and related genera figured by Yamada (1953). The overall appearance of the tympanic bone very closely resembles that of adults of *Globicephala*, particularly in the rounded anterior end. The incus differs from those figured by Yamada (1954) in that the major crus is slenderer and the minor crus longer proportionately, and the facet at the end of the minor crus is lacking.

The vertebral formula is $C_7 T_{12} L + C_{46}$, for a total of 65 vertebrae, at least two fewer than the previously recorded minimum for the species. However, the very small terminal vertebral remnant noted by Yamada was not recovered in our preparation. The vertebral column (Fig. 7) was only partially ossified. Incompletely ossified neural processes of varying shape crested the first 55 centra, but transverse processes and chevron bones were still completely cartilaginous. The uncinat processes noted on the thoracic vertebrae of all previous specimens are not apparent. The first two cervical vertebral centra are fused. In the adult specimens from Japan, the first three to six vertebrae were fused.

The first six of the 12 pairs of vertebral ribs are two-headed, and there are five pairs of ossified sternal ribs (Figs. 6, 8). The ossified sternum (Fig. 8) consists of two unfused elements, of which the anterior one is expanded and bilobed anteriorly and the second has convex sides.

The scapulae (Fig. 8) are uneroded. The short acromion process turns anteriorly rather than posteriorly as in previously described specimens (Yamada, 1954; Pryor et al., 1965).

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LITERATURE CITED

- Briggs, J. C.
1961. The East Pacific Barrier and the distribution of marine shore fishes. *Evolution* 15: 545-554.
- Cadenat, J.
1958. Notes sur les Delphinidés Ouest-africains II — Un spécimen du genre *Feresa* capturé sur les côtes du Sénégal. *Bull. Inst. Franc. Afrique Noire* 20: 1486-1491.
- Committee on Marine Mammals, American Society of Mammalogists
1961. Standardized methods for measuring and recording data on the smaller cetaceans. K. S. Norris (Ed.) *J. Mamm.* 42: 471-476.
- Ekman, S.
1953. Zoogeography of the sea. Sidgwick and Jackson, London, 417 p.
- Fraser, F. C.
1960. A specimen of the genus *Feresa* from Senegal. *Bull. Inst. Franç. Afrique Noire* 22: 699-707.
- Gray, J. E.
1871. Supplement to the catalogue of seals and whales in the British Museum. (Not seen.)

1875. *Feresa attenuata*. *J. Mus Godeffroy, Hamburg, Heft* 8: 184 + pl.6.
- Hall, E. R., and K. R. Kelson
1959. The mammals of North America. Ronald Press, N.Y., 2 vols.
- Hubbs, C. L., and R. H. Rosenblatt
1961. Effects of the equatorial currents of the Pacific on the distribution of fishes and other marine animals. Tenth Pacific Sci. Congr., Abst. Sym. Papers. Honolulu, Hawaii, p. 340-341.
- LaViolette, P. E., and S. E. Seim
1969. Monthly charts of mean, minimum and maximum sea surface temperature of the North Pacific Ocean. Spec. Publ. 123, Naval Oceanogr. Office, Washington, D.C., 58 p.
- Nishiwaki, M., T. Kasuya, T. Kamiya, T. Tobayama, and M. Nakajima
1965. *Feresa attenuata* captured at the Pacific coast of Japan in 1963. *Sci. Rep. Whales Res. Inst. Tokyo* 19: 65-95.
- Perrin, W. F.
1969. Using porpoise to catch tuna. *World Fishing* 18: 42-45.
- Pryor, T., K. Pryor, and K. S. Norris
1965. Observations on a pygmy killer whale (*Feresa attenuata* Gray) from Hawaii. *J. Mamm.* 46: 450-461.
- Rosenblatt, R. H., and B. W. Walker
1963. The marine shore-fishes of the Galápagos Islands. *Calif. Acad. Sci. Occ. Papers* 44: 97-106.
- Scammon, C. M.
1874. The marine mammals of the northwestern coast of North America. Described and illustrated. Together with an account of the American whale fishery. G. P. Putnam's Sons, N.Y. 319 p. + v. Facsimile editions by Dover Pub., N.Y. (1968); and Manessier Pub. Co., Riverside, Calif. (1969).
- Slijper, E. J.
1962. Whales. Basic Books, N.Y. 475 p.
- Yamada, M.
1953. Contribution to the anatomy of the organ of hearing of whales. *Sci. Rep. Whales Res. Inst. Tokyo* 8: 1-80.
1954. An account of a rare porpoise, *Feresa* Gray from Japan. *Sci. Rep. Whales Res. Inst. Tokyo* 9: 59-88.

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